REDUCTION OF SUPRACONDYLOID FRACTURE OF HUMERUS,

(EXTENSION TYPE) BY PRELIMINARY HYPEREXTENSION OF THE FOREARM, AND MAINTENANCE OF THE REDUCTION BY EXTREME FLEXION.

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Method of Reduction.—In this connection attention is especially directed to the layer of periosteum (Case I, Fig. 1) stripped off from the posterior surface of the upper fragment for some distance above the seat of fracture, which at the same time remains attached to the posterior surface of the lower fragment, thus forming a hinge on which the latter can be swung forward and backward and turned upward and downward. This anatomical condition is pictured in Scudder's "Treatment of Fractures." It is the object of this paper to demonstrate that this periosteal attachment between the fragments is obviously the active deterring influence in the reduction of this fracture. Since the lower fragment as it swings backward on the periosteal hinge describes the arc of a circle, there must be a tendency, though slight within so small an arc, for the posterior edge of this fragment, which is the line on the latter from which the periosteal hinge takes its departure, to become raised to a higher level than it was in its normal position. With the position of the lower fragment, thus influenced by this restraint on its posterior border, it can be seen that any manipulation which tilts the anterior edge of this fragment upward, as flexion of the forearm, tends to lock the fragments together, thereby obstructing reduction, while a manipulation tilting the front of the lower fragment downward, as would be produced by hyperextension of the forearm, would throw the fractured surfaces apart at an angle which opens anteriorly, and at the same time would relax the periosteum behind, thus unlocking the fragments and placing them in a position favorable to reduction. In this position of hyperextension the lower fragment can, with a little downward traction, be swung unobstructedly forward until the loosened periosteal layer comes again into its normal relation against the posterior surface of the upper fragment, when flexion of the forearm will tilt the anterior edge of the lower fragment upward, thereby completing the re-establishment of the normal bony relations. The test of having obtained a complete reduction of the deformity, unless interfered with by swelling, would be the ability to secure extreme flexion of the forearm.

Maintenance of Reduction.—After the fracture has been reduced the periosteum behind will prevent forward displacement of the lower fragment, while the position of extreme flexion of the forearm prevents forward riding of the upper fragment by the pressure exerted on the latter by the parts within the flexure of the elbow. Fig. 2 of Case IV shows how the coronoid process can come against the anterior margin of the upper fragment in extreme flexion and hold it in place. The proposition is herewith advanced that *extreme* flexion of the forearm is essential in order to maintain complete reduction, since otherwise pressure is not brought firmly against the front of the lower end of the upper fragment. Swelling at the outset may interfere with getting the amount of flexion necessary to maintain a complete reduction. A thin layer of absorbent cotton is placed between the skin surfaces at the flexure of the elbow to prevent irritation, besides which no constricting or compressing agent is introduced at this situation. Then the skin surface of the extremity is protected with a flannel bandage and a plaster of Paris splint is applied. The plaster bandages pass first circularly around the wrist and the upper part of the arm, encasing each singly, and then around both together down to the elbow (Case III, Fig. 3). The former turns prevent the splint from dropping off, the latter maintain the flexion. Neither flannel nor plaster bandage should pass across the flexure of the elbow, as this would destroy the position of extreme flexion. In the literature on the subject Broca[1] commenting on the method of treating this fracture in the extended position as advocated by Berthomier[2] and by Laroyenne, states, "The fracture can with certainty be reduced by traction in the extended position with direct replacement from before backward . . . . since this completely overcomes all muscular action." Both Broca and Scudder favor treatment in the acutely flexed position. Scudder, in the legend of an X-ray plate showing the deformity of this fracture, says, "It is often impossible to reduce this fracture without incision."

Cases.—The important features are indicated in the legends of the illustrations. The first case was one with tremendous swelling. Several attempts at reduction were made before the final partial reduction was secured on the 20th day (Case I, Fig. 3). In one of these attempts, where strong traction was made with a bandage in the flexure of the joint while the forearm was forced into flexion, an evidence of the periosteal hinge being a deterrent factor to reduction was demonstrated by the X-ray of the result which showed that the lower fragment had been tilted backward and the lower end of the upper fragment was in relation with its anterior surface. Early in the history of this case the great swelling precluded the employment of acute flexion in maintaining the fragments in reduction. The other three cases were all reduced by hyperextension preceding reduction, the forearm in each case could be readily brought up into forced flexion in which position the fracture was set in plaster, and all three cases had excellent results. Case IV was the only one not set under anæsthesia.

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[1] Leçons Clinique de Chirurgie Infantile, p. 93.

[2] Congrès français de Chir., 1875 and 1888.

FIG. 1.

CASE I (1). Age 11. 12th day. Condition before attempted reduction. A linear shadow indicates the situation of the periosteum stripped from the posterior surface of the upper fragment for some distance above the seat of fracture, and at the same time remaining attached to the lower fragment. *The primary relaxation of this periosteal hinge by hyperextension of the forearm is essential in the reduction of this fracture.*

FIG. 2.

CASE I (2) shows result of attempted reduction 14th day, by holding the forearm at a right angle and then with downward traction on the condyles pressing backward on the upper fragment and forward on the olecranon process. *The tension of the periosteal hinge unrelaxed by this position of the forearm had held the fragments locked in the position of deformity, thereby preventing reduction by this manipulation.*

Fig. 3.

Case I (3) Shows partial reduction, 20th day. With the forearm hyperextended the lower fragment was readily pressed forward and the forearm then came up into acute flexion with perfect ease. *Having previously failed to secure reduction in this case without hyperextension of the forearm, the efficacy of this method would seem to have been herewith demonstrated.* An iron spring and felt pads were relied upon chiefly to maintain the reduction, the forearm being thereby held in acute but not extreme flexion. The subsequent three cases demonstrate the possibility of maintaining a more perfect reduction simply by the position of extreme flexion.

FIG. 4.

CASE I (4) Shows result after 5½ months. Forced flexion. Acute flexion could be gained by force for about fifteen months, subsequent to which an obstructing callus developed. Forced extension would bring the forearm quite a little below a right angle.

FIG. 5.

CASE II. Age about 5. X-ray showing result 3½ months after setting by hyperextension of forearm with downward traction on condyles and forward pressure on the lower fragment and then bringing the forearm into extreme flexion. Some swelling at the time of setting. *Result:* Lacks about three degrees of full extension, otherwise perfect motion.

FIG. 6

CASE III (1). Age about 6. Original deformity.

FIG. 7.

CASE III (2). Fracture reduced by the hyperextension method, and set in plaster in the position of extreme flexion. After making three or four unsuccessful efforts at reduction, the lower fragment finally slipped forward with a little snap and the forearm came easily up into extreme flexion. *Result:* Perfect motion.

Fig. 8.

Case III. (3) Plaster of Paris splint holding forearm in extreme flexion.

FIG. 9.

CASE IV (1) Age 60. Original deformity.

Fig. 10.

Case IV (2). Fracture reduced by the hyperextension method, and set in plaster in the position of extreme flexion. The X-ray shows how the coronoid process in this position of the forearm, by impinging on the anterior margin of the upper fragment, can influence the maintenance of reduction. *Result:* 7 months after removal of the plaster the patient wrote that his arm was "all right."